7 - Indianapolis
Exceptional Events Detail

Parameter: $PM_{2.5}$

Dates: May 23 – 31, 2007

Location: Indianapolis – Marion Co.

Event: Smoke from wildfires in northern Florida and southern Georgia impacted the Indianapolis region during the period of May 23 – 31. The gradual buildup of smoke moving through the area during this period resulted in exceedances of the 24-hour $PM_{2.5}$ NAAQS on May 23rd at English Ave. (18-097-0066) and Washington Park (18-097-0078), May 25th at English Ave, May 29th at both English Ave. and Washington Park and several elevated readings throughout the region.

Data: Different analyses of the data are used to demonstrate that the $PM_{2.5}$ concentrations measured from May 23 – 31 have been influenced by outside events. Table 7.1 shows daily $PM_{2.5}$ averages prior to, during and after the event with the values flagged in **bold**. Data have been flagged with an exceptional event flag of 'E' in AQS, awaiting concurrence from EPA.

Tables 7.2 and 7.3 list summaries of the data collected at Indianapolis sites the since 2000. Data from 2007 are calculated with all current data and with the flagged data removed along with recalculated design values.

There are no changes in the Daily Design Values at the sites with the flagged data removed. All currently operating sites will remain above the daily NAAQS. Even though several sites continue to remain over the annual NAAQS after the flagged data are removed from the calculations, there is significant improvement of the 2007 annual averages. These improved values may be the difference between nonattainment and attainment of the annual NAAQS when the design values are calculated for 2006-2008 and for 2007-2009.

Table 7.1 – FRM Daily Values

Exceptional Event Period

Values in **BOLD** are flagged as exceptional events

Date	Indpls - E. Michigan 18-097-0083	Indpls - E. 75th St. 18-097-0079	Indpls - W. 18th St. 18-097-0081	Indpls - Mann Rd. 18-097-0042	Indpls - S West St. 18-097-0043	Indpls - English Ave 18-097-0066	Indpls - Wash Park 18-097-0078
5/17/07						7.5	6.2
5/18/07	8.1	7.9	6.8	7	8.4	9.5	6.9
5/19/07						16.9	12.4
5/20/07						17.2	14
5/21/07	18.4	16.3	17.7	16.3	24.4	19.4	19.1
5/22/07						23.1	22.5
5/23/07						**37.9**	**38.5**
5/24/07	**30.2**	**30.5**	IN	**30.7**	**31.6**	**33.1**	**31.9**
5/25/07						**35.8**	**34.9**
5/26/07						**31.3**	**29.3**
5/27/07	**25.3**	**25.2**	**25.4**	**23**	**25.1**	**26.6**	**24.5**
5/28/07						**28.7**	**26.3**
5/29/07						**37.9**	**37.6**
5/30/07	**32.9**	**32.4**	**32.4**	**31**	**33.2**	**34.1**	**34.1**
5/31/07						**34.6**	**32**
6/1/07						29.4	26.5
6/2/07	21.6	18.9	19.3	18.7	21.1	23	20.2
6/3/07						19.4	19.2

Table 7.2 - Historical Daily Values

Year		Indianapolis - E Michigan 180970083		Indianapolis - E 75th St 180970079		Indianapolis - W 18th St 180970081		Indianapolis - Mann Rd 180970042	
		98th %ile	Daily Design Value[1]	98th %ile	Daily Design Value[1]	98th %ile	Daily Design Value[1]	98th %ile	Daily Design Value[1]
2000		35.7		35.1		36.3		33.5	
2001		39.5		35.9		38.5		31	
2002	2000-2002	36.7	37	33.3	35	26.8	34	39.6	35
2003	2001-2003	36.7	38	38	36	36.2	34	33.7	35
2004	2002-2004	31.3	35	28.7	33	31.9	32	29.3	34
2005	2003-2005	40.3	36	43.4	37	45.7	38	39.4	34
2006	2004-2006	33.5	35	30.7	34	34.8	37	31	33
2007	2005-2007	37.2	37	33.5	36	38.4	40	35.6	35
		Values Excluding Flagged Data							
2007	2005-2007	37.2	37	33.5	36	38.4	40	35.6	35

[1]Daily Design Value = 3 year average of annual 98th %ile values.

Table7.2 (con't) - Historical Daily Values

Year		Indianapolis - S West St 180970043		Indianapolis - English Ave 180970066		Indianapolis – Washington Park 180970078	
		98th %ile	Daily Design Value[1]	98th %ile	Daily Design Value[1]	98th %ile	Daily Design Value[1]
2000		36.8		39.5		36.5	
2001		36.4		44.1		37.2	
2002	2000-2002	36.5	37	44.8	43	35	36
2003	2001-2003	37.9	37	39.4	43	39.3	37
2004	2002-2004	31.7	35	31.1	38	31	35
2005	2003-2005	43.9	38	44	38	42.5	38
2006	2004-2006	37.5	38	36.2	37	31.7	35
2007	2005-2007	38.3	40	38.8	40	38.8	38
		Values Excluding Flagged Data					
2007	2005-2007	38.3	40	38.8	40	38.8	38

[1]Daily Design Value = 3 year average of annual 98th %ile values.

Table 7.3 - Historical Annual Averages

Year		Indianapolis - E. Michigan St. 180970083		Indianapolis - E 75th St 180970079		Indianapolis - W 18th St 180970081		Indianapolis - Mann Rd 180970042	
		Annual Ave.	Annual Design Value[2]	Annual Ave.	Annual Design Value[2]	Annual Ave.	Annual Design Value[2]	Annual Ave.	Annual Design Value[2]
2000		17		16.4		16.8		15.2	
2001		17.1		16.2		17.1		14.8	
2002	2000-2002	16.7	16.9	15.7	16.1	14.2	16.1	15.2	15.1
2003	2001-2003	16.3	16.7	14.7	15.5	16.2	15.9	14.5	14.8
2004	2002-2004	15	16	13.4	14.6	15	15.1	12.9	14.2
2005	2003-2005	17.5	16.3	16.9	15	18.1	16.4	16.1	14.5
2006	2004-2006	14.1	15.6	12.7	14.4	14.1	15.7	12.5	13.8
2007	2005-2007	15.9	15.9	14.8	14.8	16.1	16.1	14.6	14.4
		Values excluding flagged data							
2007	2005-2007	15.6	15.7	14.3	14.7	15.8	16	14.2	14.3

[2]Annual Design value = 3 year average of the annual averages.

Table 7.3 (con't) - Historical Annual Averages

Year		Indianapolis - S West St 180970043		Indianapolis - English Ave 180970066		Indianapolis - Washington Park 180970078	
		Annual Ave.	Annual Design Value[2]	Annual Ave.	Annual Design Value[2]	Annual Ave.	Annual Design Value[2]
2000		18.4		18.9		17.7	
2001		17.7		18.6		16.6	
2002	2000-2002	17	17.7	18.3	18.6	16.6	17
2003	2001-2003	17.2	17.3	17.5	18.1	15.4	16.2
2004	2002-2004	15.7	16.6	16.7	17.5	14.3	15.4
2005	2003-2005	19.1	17.3	19.3	17.8	16.4	15.4
2006	2004-2006	15.5	16.8	15.2	17.1	14.1	15
2007	2005-2007	17.3	17.3	17.3	17.3	15.8	15.4
Values excluding flagged data							
2007	2005-2007	16.9	17.2	16.7	17.1	15.3	15.3

[2]Annual Design value = 3 year average of the annual averages.

Particulate Composition: Speciation data are collected at the Indianapolis – Washington Park on a one in three day sampling schedule. Data are available for May 24, 27, and 30. High organic carbon values were reported on those three dates; 7.72 ug/m3, 7.81, and 8.54 ug/m3 respectively. These values were the highest values reported in 2007. The annual average for organic carbon at this site was 3.4 ug/m3. The elemental carbon values during this period were from 1.0 ug/m3 to 1.6 ug.m3. The high organic carbon values, without high elemental carbon, are a very good indicator of biomass combustion. Maps with the plotted organic carbon values during the May 18 through June 5 are in Appendix 3. The time progression of the maps shows the rise and fall of the organic carbon values over this time period.

Maps: Images of maps from NOAA Satellite and Information Services show the smoke plume originating from the northern Florida/southern Georgia region. Dispersion and movement of the smoke plume from these fires was generally to the west or northwest and then to the north. The daily satellite smoke photos show that the smoke plume from the fires extends statewide on May 23 and 24. The plume recedes farther to the south and east until May 29, but continues to influence the $PM_{2.5}$ readings in Indianapolis. It continues to influence all sites statewide until May 31. The daily wind roses obtained from the nearest meteorological site at Indianapolis - E. 16th St.,

18-097-0073) show information on prevailing wind direction, calm conditions and wind speed. NOAA weather maps are also used to show that an upper level trough greatly influences the direction of the plume in relation to the Indianapolis region.

Trajectory Modeling: The NOAA HYSPLIT Models are used to show wind trajectories at different levels during this event. Backward modeling from the site (latitude: 39.81°; longitude: -86.11°) at elevations of 25m, 150m and 500m was conducted for a period of three (3) to four (4) days prior. The differing elevations were chosen to demonstrate the air mass's uniformity at ground-level where the samplers were located and aloft which avoids the ground-level limitations of the model. Forward modeling was conducted using the Bugaboo Scrub Fire as the starting point (latitude: 30.70°; longitude: -82.40°) at an elevation of 250 meters (appropriate height that is low enough to always be in the well-mixed zone and high enough to avoid the ground-level model limitation) and going three (3) to four (4) days. Overall, there is a very good correlation when comparing the forward and backward trajectories for a given date. For example, May 24, 26, and 29 show a very narrow channel of air flow between southeastern Georgia and southwestern Indiana. Forward trajectory modeling can be found in Appendix 2.

Conclusion: EPA defines an "exceptional event" as an unusual or naturally occurring event that can affect air quality but is not reasonably controllable by state and local agencies. Exceptional events are events for which the normal planning and regulatory process established by the clean air act is not appropriate. It has been illustrated through the use of maps, meteorological data, speciation data, trajectory models and historical data that the smoke from wildfires in Florida and Georgia impacted the Indianapolis region during the period of May 23 – 31, 2007 causing exceedances of the $PM_{2.5}$ 24-hour standard, high daily sampled values, and significantly increasing the annual average. When removing the data from this time period, there is an improvement in the annual averages for 2007 and the annual design value for 2005-2007. According to 40 CFR Part 50.14 (b)(1), "EPA shall exclude data from use in determinations of exceedances and NAAQS violations where a State demonstrates to EPA's satisfaction that an exceptional event caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section." IDEM believes they have successfully illustrated the impact of this event on the sites in this region.

Therefore, IDEM requests that EPA concur with the 'E' flag on the data in AQS for the data in **bold** in Table 7.1.

NOAA Satellite Smoke Maps, Weather Maps, and Wind Roses

The smoke map shows that the plume has reached the Indianapolis area and as shown in Table 7.1, $PM_{2.5}$ levels have started to increase. The corresponding wind rose and weather map further illustrate the direction of the plume by the location of the upper level trough (orange dashed line) and the S, SE prevailing winds.

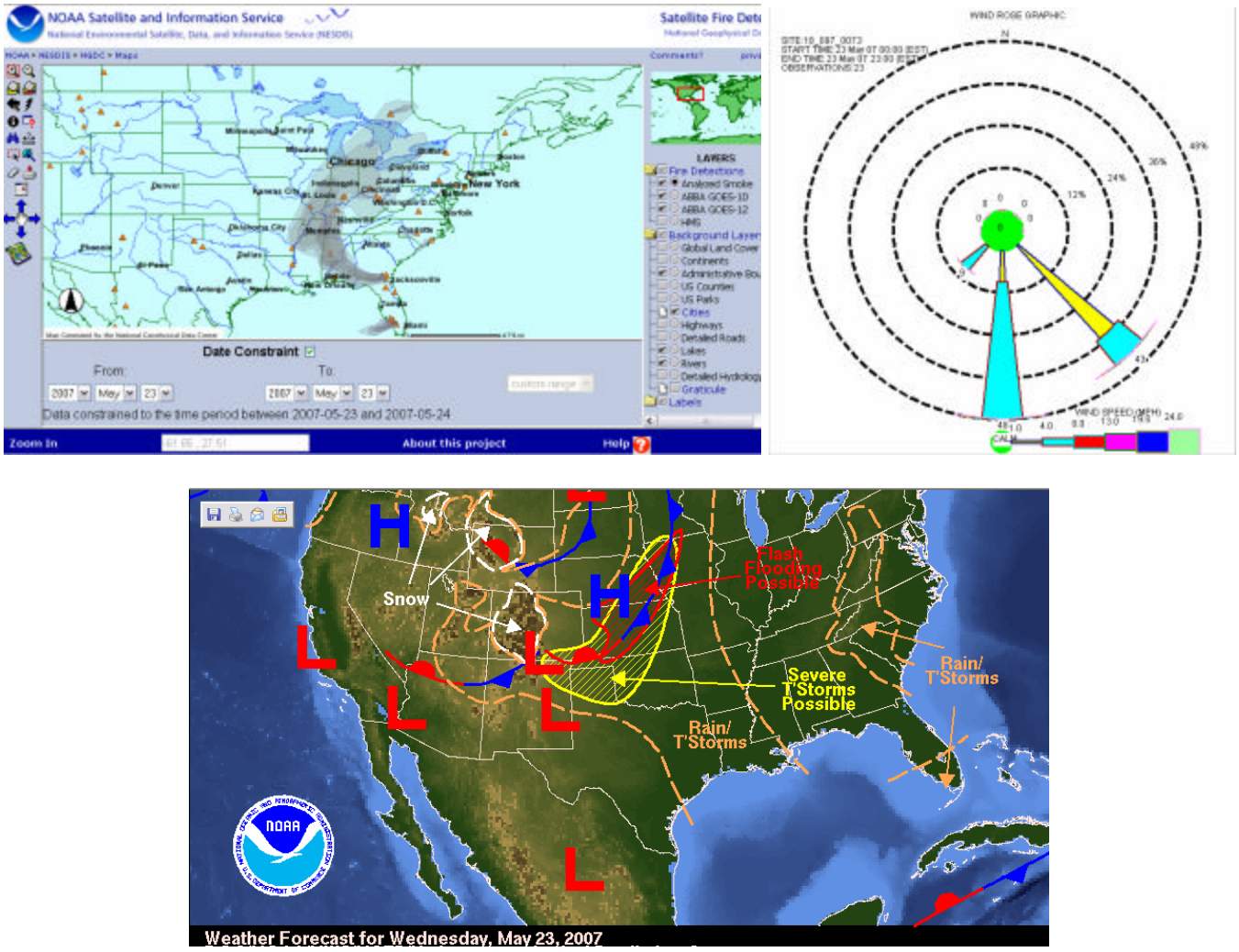


Figure 7.1 - May 23, 2007

The smoke map shows that the plume is remaining over the area. The prevailing wind direction has shifted to the SSW as the upper level trough moves further to the east and another trough develops over Ohio, keeping the plume over the SW Indiana region.

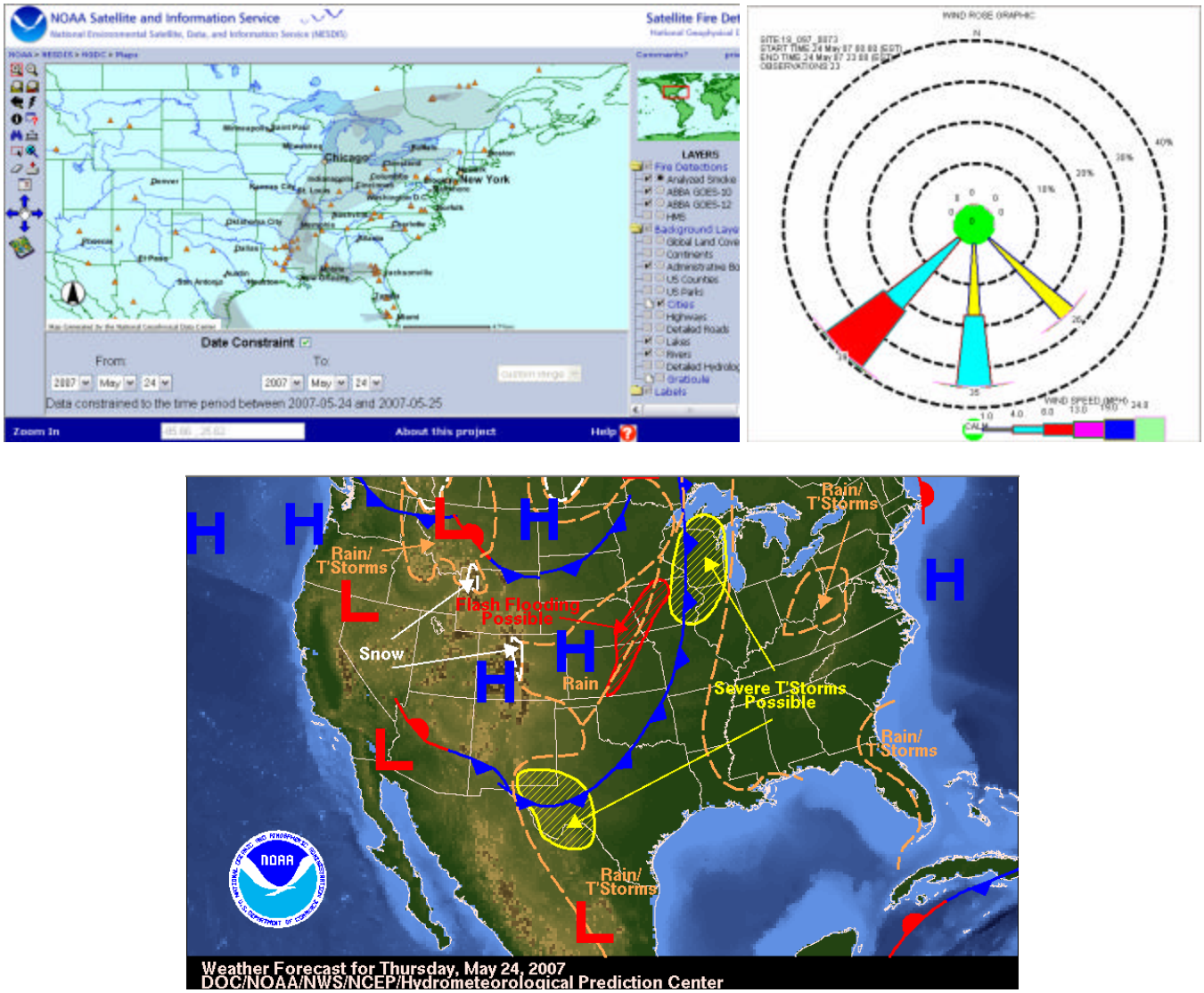
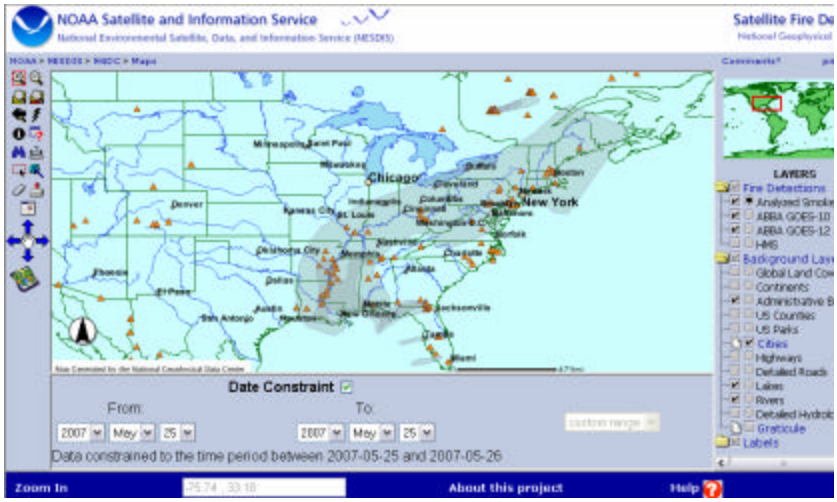
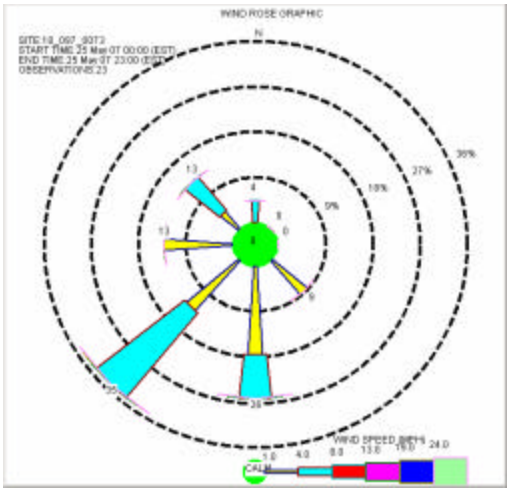


Figure 7.2 - May 24, 2007

The smoke map shows that the plume is remaining over the area. The prevailing wind direction continues to be from the SSW as the upper level trough has now moved directly over the Indianapolis area.





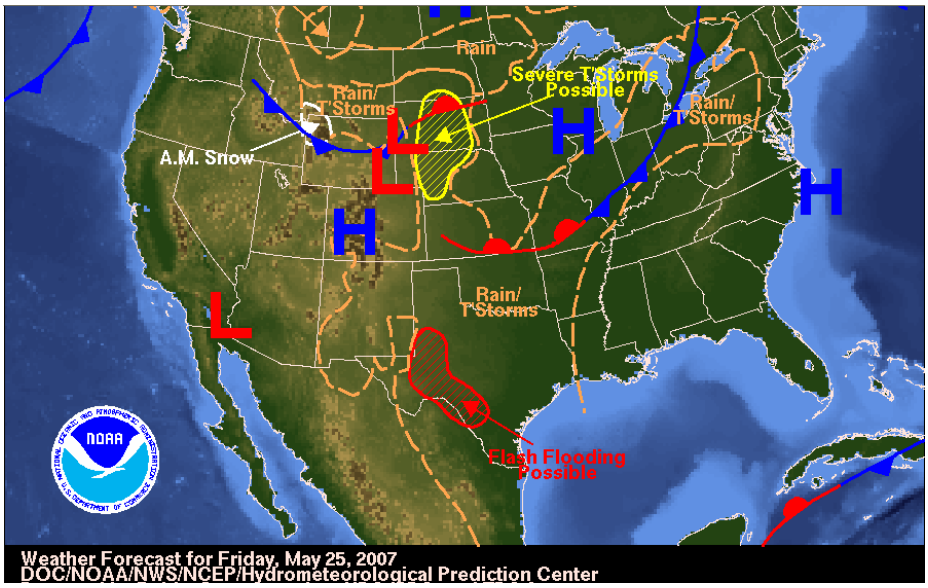


Figure 7.3 - May 25, 2007

The smoke map illustrates that the plume has essentially dissipated as the trough keeps the smoke pushed to the south. However, due to the extremely calm wind conditions the stagnant air mass continues to cause the $PM_{2.5}$ levels to rise past the 24-hour standard.

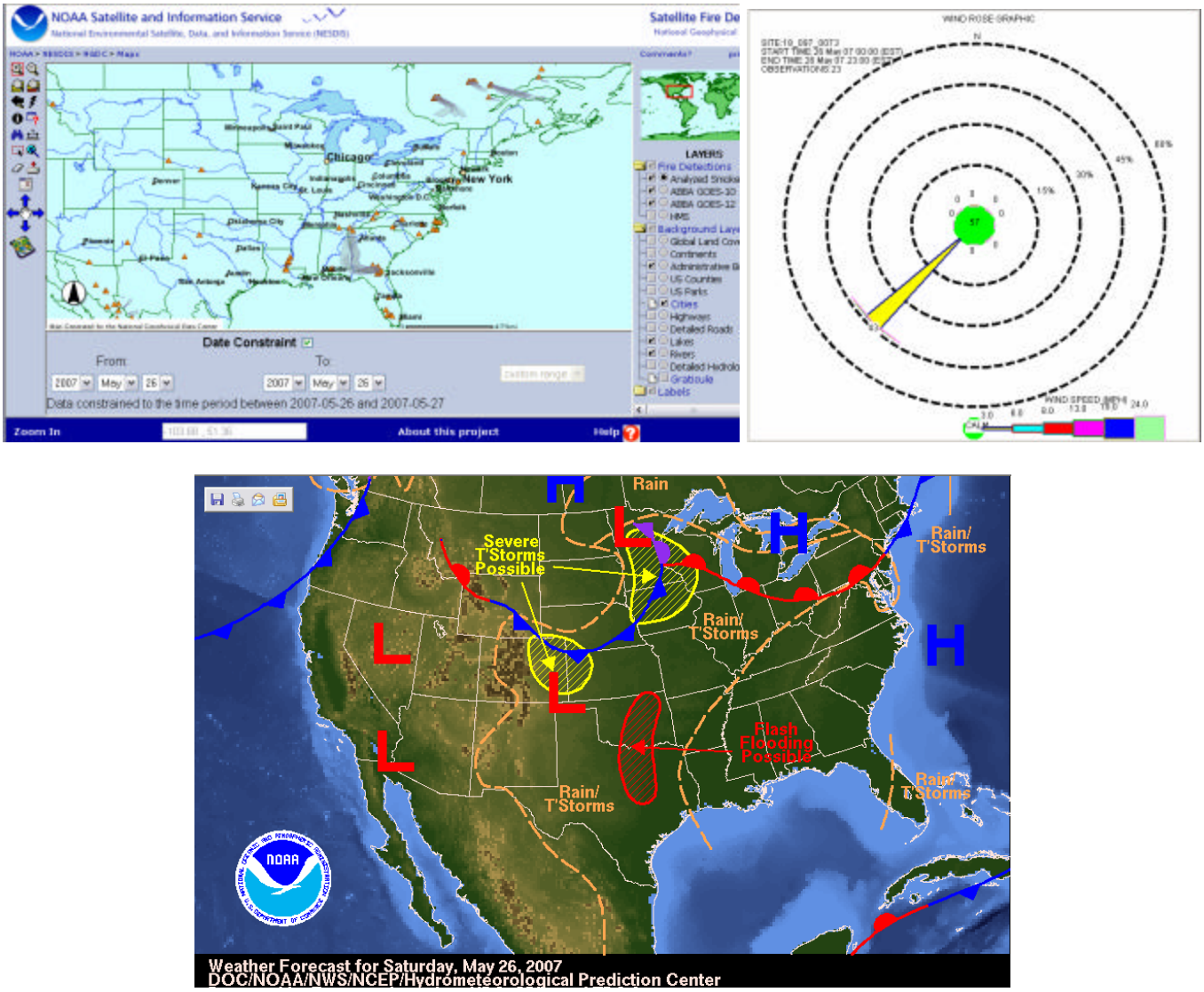
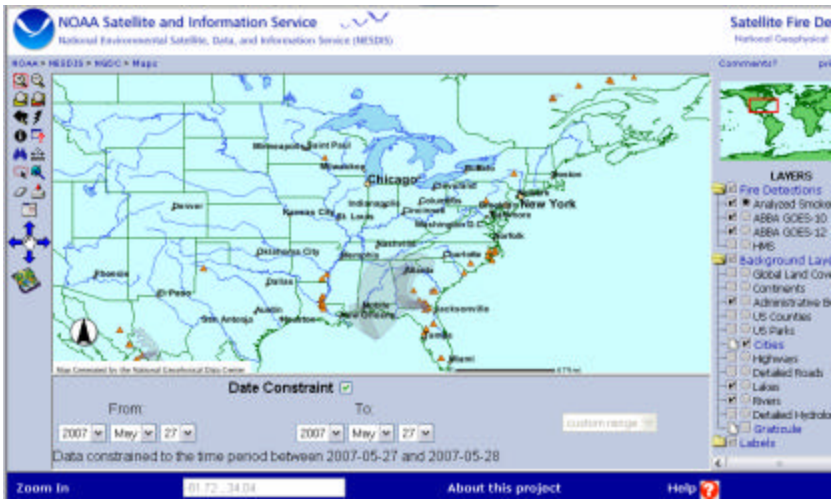
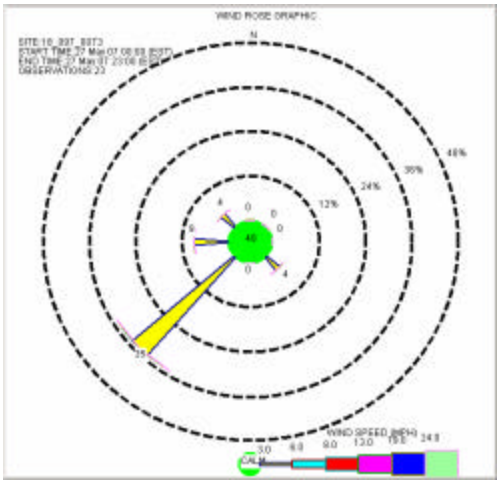


Figure 7.4 - May 26, 2007

The smoke map illustrates that the plume continues to stall as the trough continues to keep the smoke pushed to the south. However, due to the extremely calm wind conditions the stagnant air mass continues to cause the $PM_{2.5}$ levels to remain elevated.





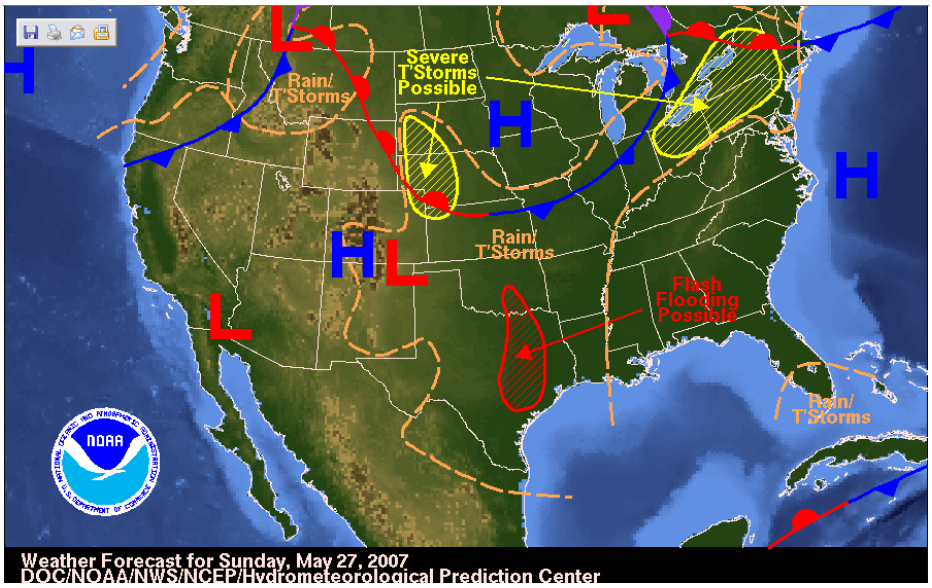
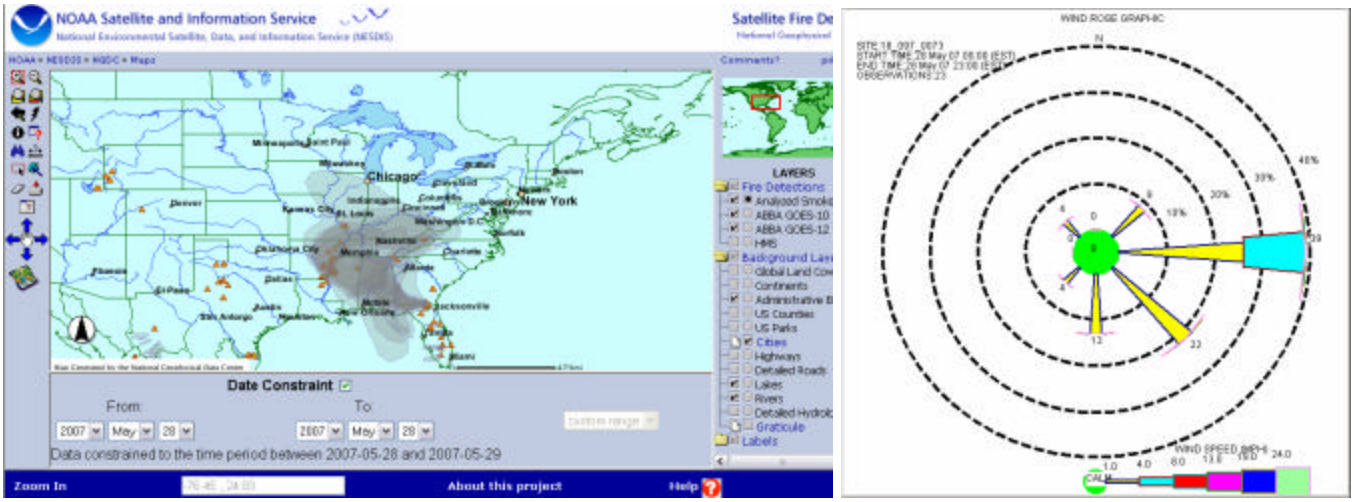


Figure 7.5 - May 27, 2007

The smoke map shows the plume has been pushed back into the region due to the upper level trough moving to the north and causing the plume to become more concentrated over the area.



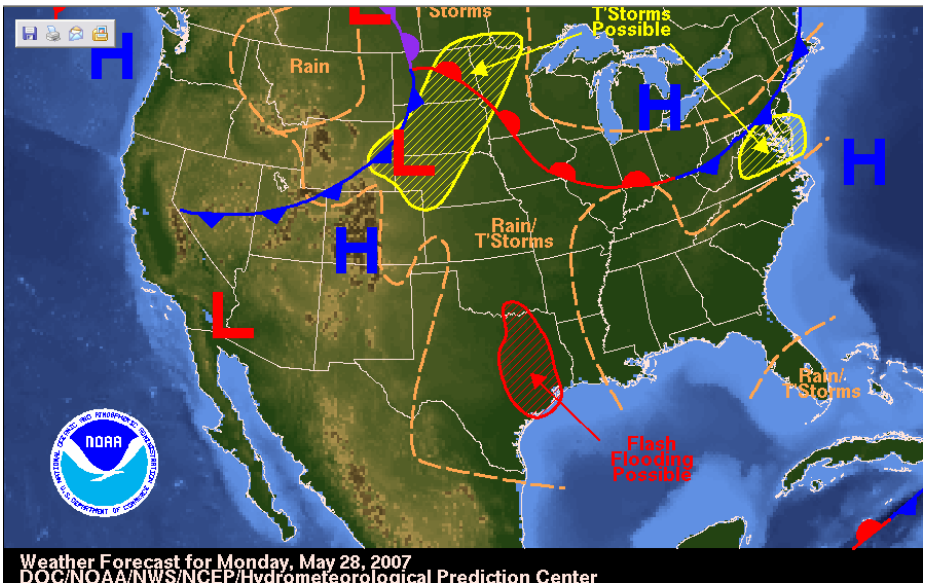


Figure 7.6 - May 28, 2007

Although the map illustrates the plume is not over the region, the extremely calm wind conditions, as shown by the wind rose, keep the high levels of $PM_{2.5}$ over the area.

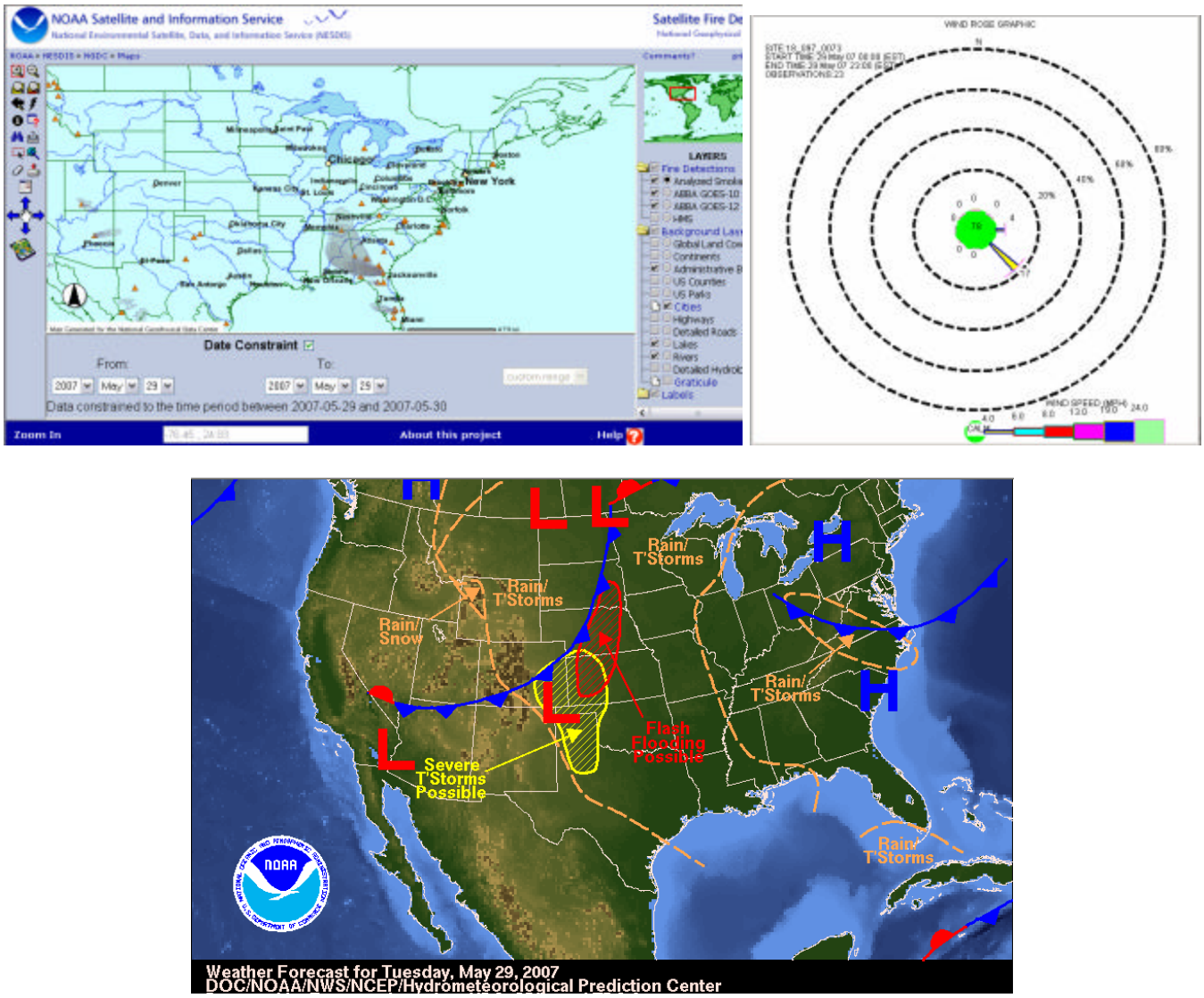
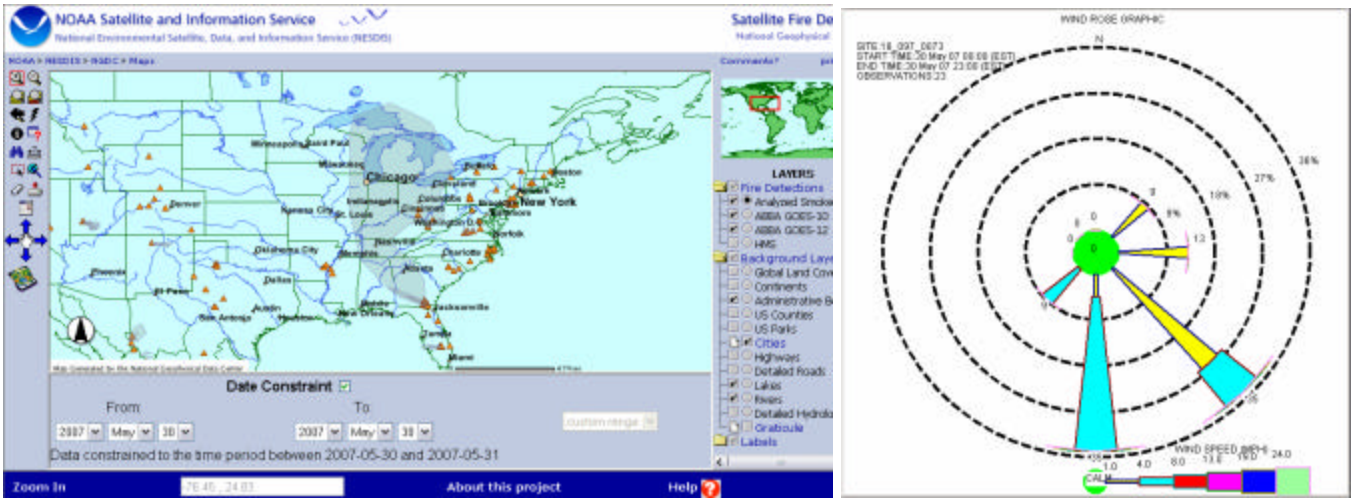


Figure 7.7 - May 29, 2007

The map shows the plume has moved back over the region as the upper level trough dips down over the area and the wind direction continues to be calm and from the SSE.



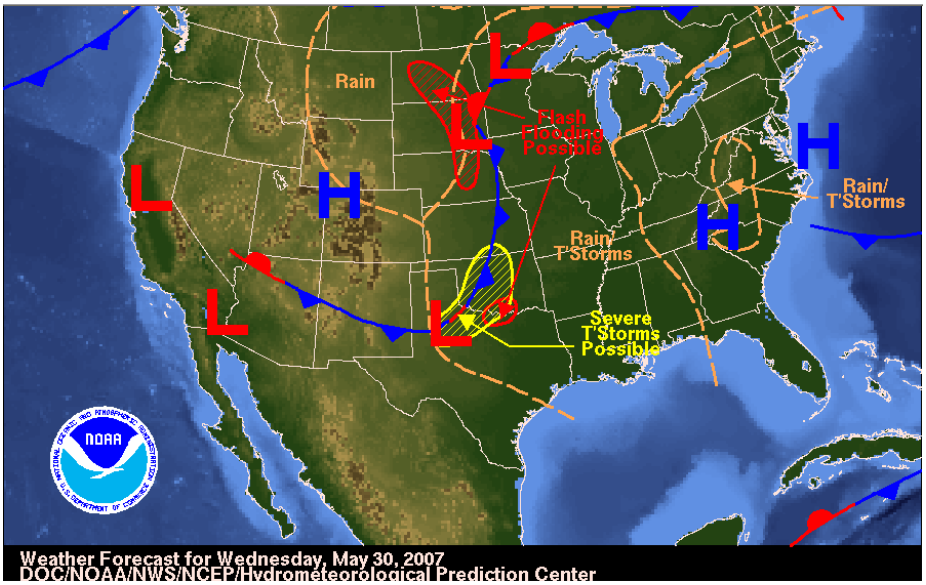


Figure 7.8 - May 30, 1997

The map shows the plume have dissipated, however, the PM2.5 levels remain elevated as the prevailing winds still remain from the S, SE.

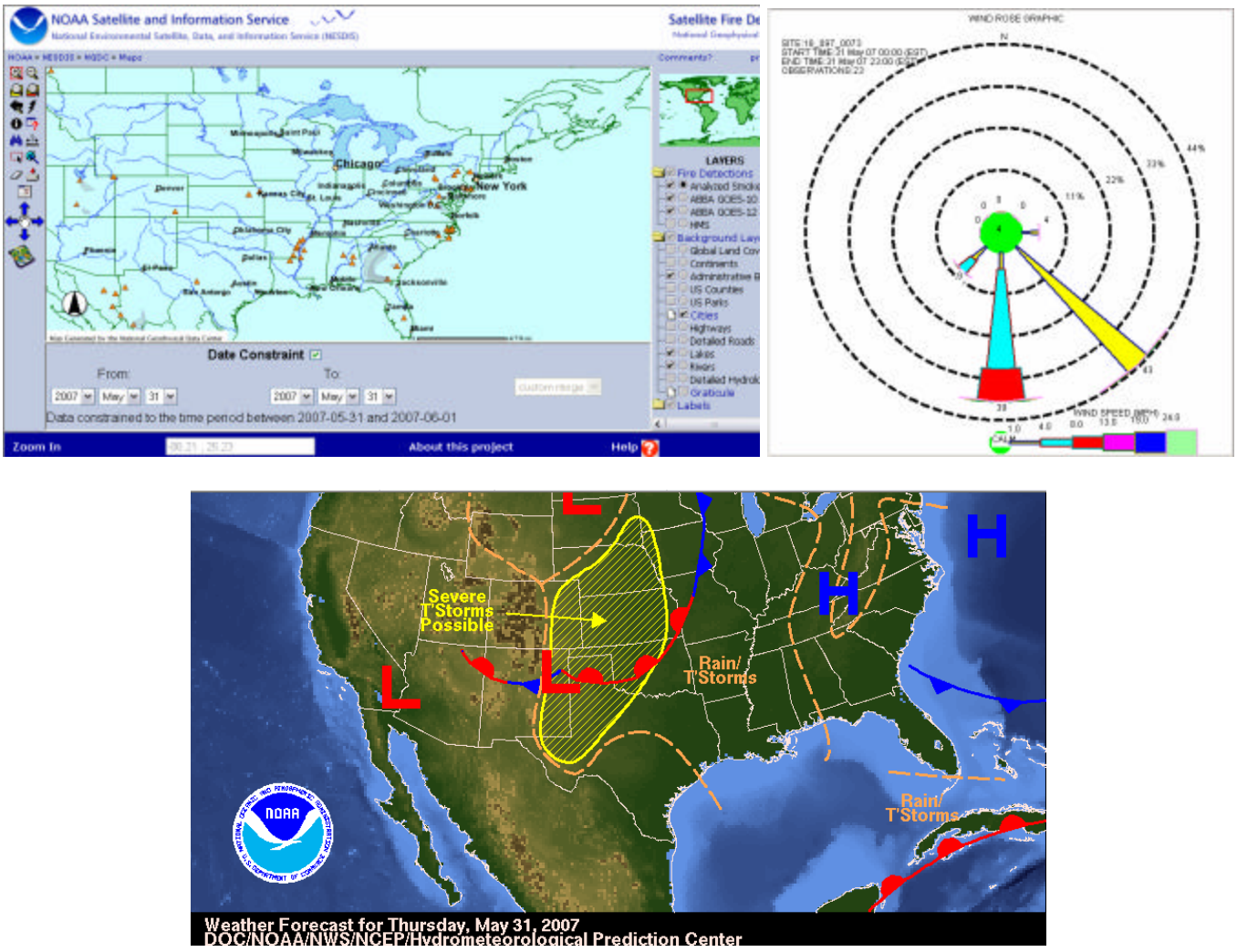


Figure 7.9 - May 31, 2007

Backward Trajectory Models

NOAA ARL READY HYSPLIT Maps

Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://www.arl.noaa.gov/ready/hysplit4.html). NOAA Air Resources Laboratory, Silver Spring, MD.

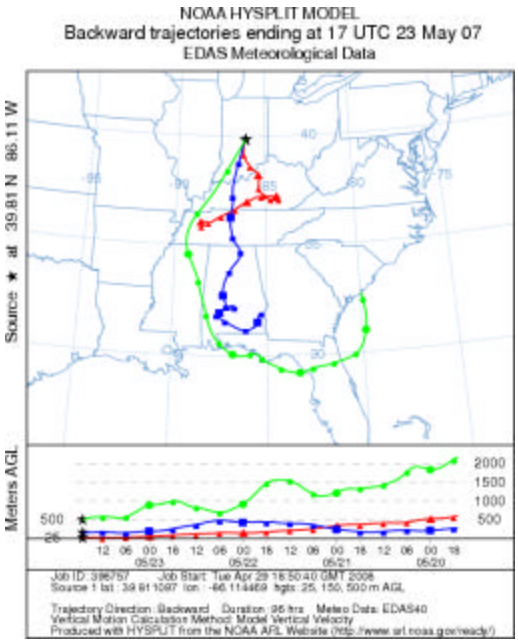


Figure 7.10: Backward trajectories originating from Indianapolis on 5/23/07 at 12:00 PM EST showing the air mass passing over northern Florida.

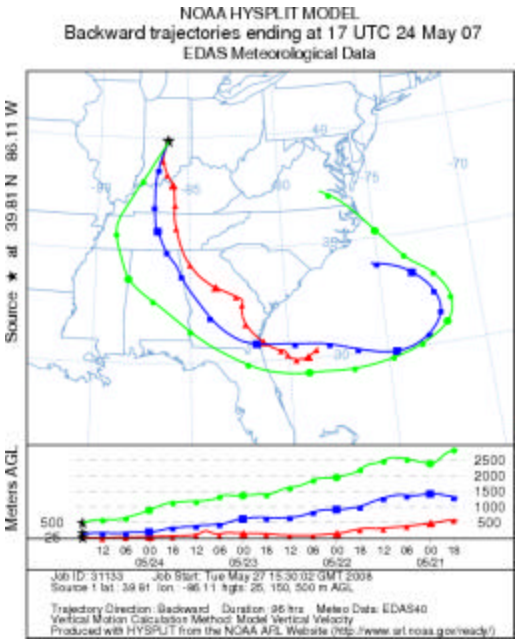


Figure 7.11: Backward trajectories originating from Indianapolis on 5/24/07 at 12:00 PM EST showing continuation of the air mass passing over southern Georgia and northern Florida.

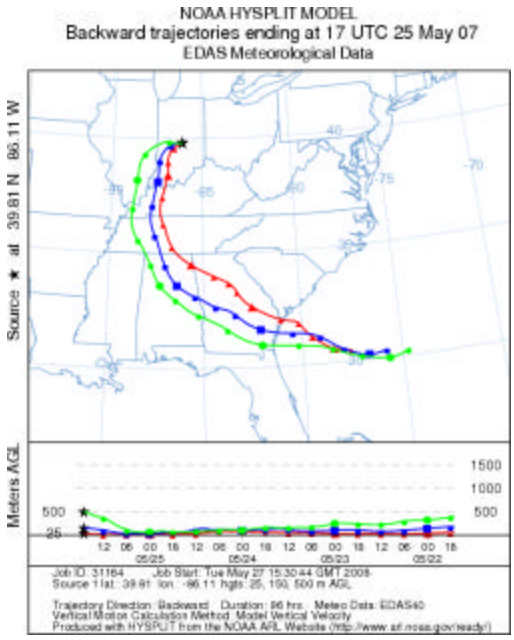


Figure 7.12: Backward trajectories originating from Indianapolis on 5/25/07 at 12:00 PM EST showing the air mass still passing over southern Georgia.

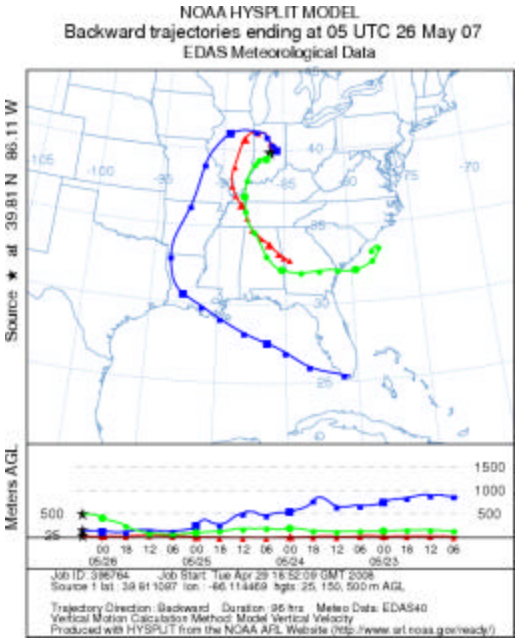


Figure 7.13: Backward trajectories originating from Indianapolis on 5/26/07 at 12:00 AM EST showing the air mass still passing over Georgia.

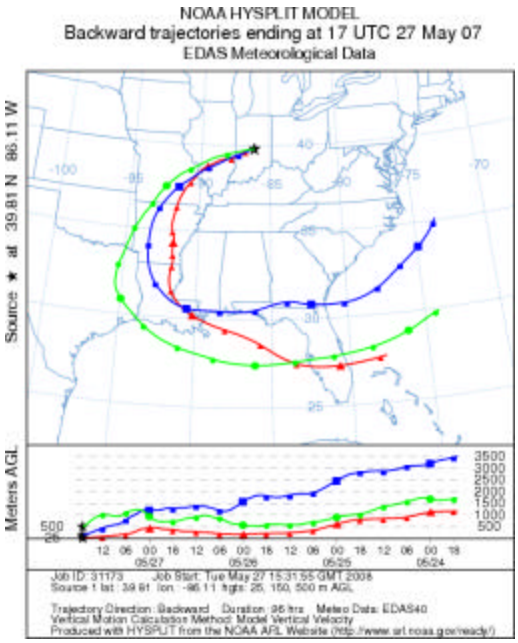


Figure 7.14: Backward trajectories originating from Indianapolis on 5/27/07 at 12:00 PM EST showing the air mass still passing over southern Georgia and Florida.

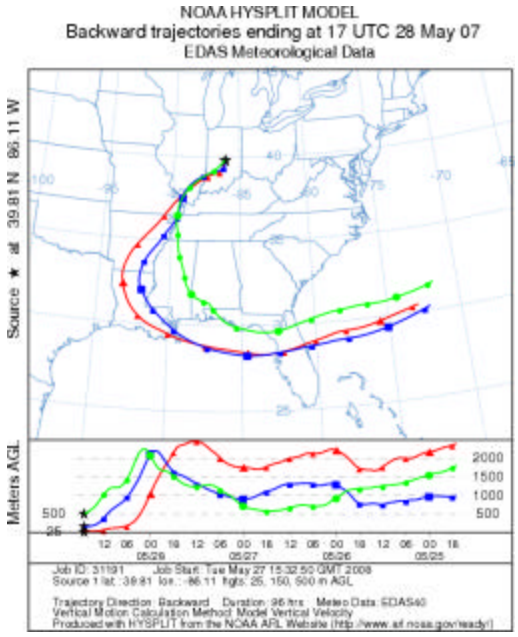


Figure 7.15: Backward trajectories originating from Indianapolis on 5/28/07 at 12:00 PM EST showing the air mass still passing over northern Florida.

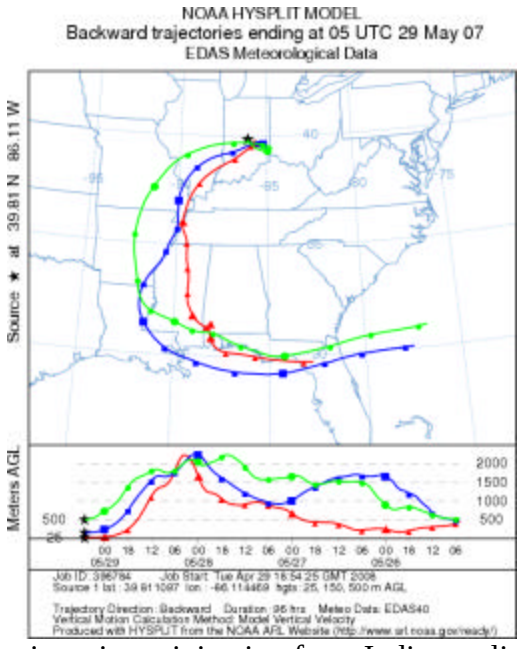


Figure 7.16: Backward trajectories originating from Indianapolis on 5/29/07 at 12:00 AM EST showing the consistency of the air mass passing over northern Florida.

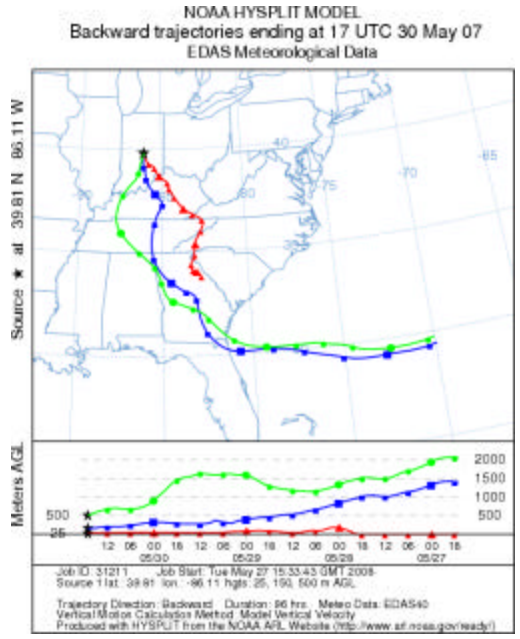


Figure 7.17: Backward trajectories originating from Indianapolis on 5/30/07 at 12:00 PM EST showing the air mass passing over Georgia.

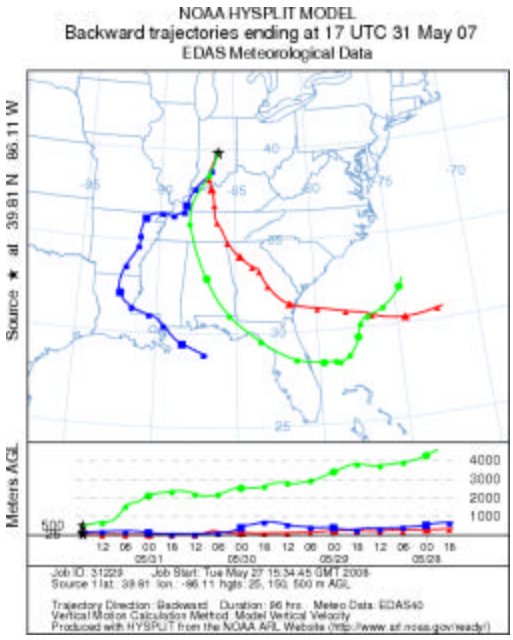


Figure 7.18: Backward trajectories originating from Indianapolis on 5/31/07 at 12:00 PM EST showing the air mass still passing over Georgia and Florida.